

REMARKS

By this amendment, Applicants have amended the specification to use all capital letters for the word "INVAR" and to accompany the word with the generic terminology "alloy comprising iron and nickel." Applicants have also amended the claims to more clearly define their invention. In particular, Applicants have canceled claims 1, 7, 13-16, 18-20 and 31 without prejudice or disclaimer. The preamble of claim 21 has been amended to read "[a] control unit for controlling an engine or transmission assembly of an automobile." The corresponding portions of the preambles of the remaining claims have been amended consistently with claim 21. The claims have also been amended to eliminate the antecedent basis and the indefiniteness problems noted by the Examiner on pages 2-6 of the Office Action. Claim 21 has also been amended to include therein the limitation previously recited in claim 27, i.e., that the polyimide wiring board is bent at at least one end and a portion of at least one end fixed to the first major surface of the heat sink via an adhesive. Claim 21 has also been amended to recite that bonding wires electrically connect the multilayered wiring board and polyimide wiring board to the external connection terminal, and that the bonding wires are provided only over the first major surface of the heat sink to which the multilayered wiring board and the portion of at least one end of the polyimide wiring board are fixed. See, e.g., Figures 6a and 7 and the description thereof in Applicants' specification.

In view of the foregoing amendments to the specification and claims, reconsideration and withdrawal of the objection to the specification and rejection of the claims under 35 U.S.C. 112, second paragraph, are requested.

Claims 1, 7, 14, 16, 18-22, 24 and 26-28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over combination of U.S. Patent No. 6,049,975 to

Clayton, U.S. Patent No. 6,023,098 to Higashiguchi et al. and U.S. Patent Application Publication No. 2003/0137032 A1 to Abbott. Applicants traverse this rejection and request reconsideration thereof.

It is an object of the present invention to realize high-density mounting, high heat-dissipating characteristics, and high reliability all at the same time in an automobile control unit, i.e., a control unit for controlling an engine or transmission assembly of an automobile, that is required to provide heat resistance and hermetic sealing under a harsh environment. The automobile control unit of the present invention has a great current value and a complicated electric circuit. Thus, it is effective to adopt a multilayered wiring board having at least two electronic components as the wiring board from the viewpoint of high density mounting. However, since such an automobile control unit is used in a high-temperature environment, a multilayered wiring board does not readily allow sufficient dissipation of heat from the heat sink. Hence, the present invention adopts a structure that a multilayered wiring board is fixed to a first major surface of the heat sink and a polyimide wiring board with at least one heat generating component with excellent heat-dissipating characteristics is fixed to a second major surface of the heat sink but has at least one end bent so that a portion is fixed to the first major surface. Thus, the heat generating component is mounted on the polyimide wiring board with excellent heat-dissipating characteristics. The wiring boards are electrically connected to external terminals by bonding wires only from the side of the first major surface. The present invention thereby enables realization of high density mounting and heat-dissipating characteristics in a harsh environment where high levels of heat resistance and hermetic sealing are required.

The Clayton patent discloses a multichip semiconductor module compatible with existing SIMM memory sockets comprising a molded module frame and a

composite semiconductor substrate assembly received in a cavity of the frame. The Examiner alleges the Clayton patent to disclose a multilayer wiring board 50 mounted with at least two electronic components 54. However, element 50 of Clayton is a thin laminate circuit, the primary purpose of which is to provide electrical or optical interconnection between individual electronic devices 54 and discrete components 56 or a group of stacked electronic devices 52 mounted on the circuit 50, and to conduct data signals and control voltages to and from the termination pads 34 or 34' on the molded frame 12. See, e.g., the paragraph bridging columns 10 and 11 of Clayton. Thus, the electronic components 54 are individual electronic devices and are not mounted on the thin laminate circuit 50.

Thus, the Clayton patent does not disclose an electronic circuit apparatus or automobile control unit including a multilayer wiring board mounted with at least two electronic components and a polyimide wiring board mounted with at least one heat generating component fixed to opposite surfaces of a heat sink, as presently claimed. Moreover, contrary to the allegations in the Office Acton, the metal plate 48 of Clayton is disclosed to be a clad material (see, e.g., claims 24 and 30). The word "clad" means that something, usually a metal, is sheathed or covered with a metal. By using a clad material, e.g., of copper-iron/nickel-copper layers, which has a low thermal-expansion property, for the heat sink, it is possible to reduce thermal stress, which would be caused under high-temperature environment due to the difference in the thermal expansion coefficients between different materials, and to prevent peeling, which would occur at the boundary between the heat sink and the mold material or between the heat sink and the wiring board. Such is not disclosed by Clayton.

Additionally, the Clayton patent does not disclose a polyimide wiring board bent at at least one end such that the polyimide wiring board is fixed to one surface

of a heat sink, and a portion of the bent end is fixed to the opposite surface of the heat sink.

Furthermore, Clayton does not disclose the combined use of a multilayered wiring board and a polyimide wiring board, whereby the multilayered wiring board is disposed on one surface of a heat sink and the polyimide wiring board is disposed on the other surface thereof, and whereby a heat generating component is mounted on the polyimide wiring board.

Clearly, since the Clayton patent does not disclose the combined use of a multilayer wiring board and a polyimide wiring board and does not disclose a polyimide wiring board bent at at least one end and fixed to both surfaces of the heat sink, the Clayton patent does not disclose the manner in which the wiring boards are electrically connected to the external connection terminal as presently claimed.

Persons of ordinary skill in the art could not easily have conceived of the automobile control unit of the present invention that realizes high-density mounting and heat-dissipating characteristics, based on the multichip module described in Clayton, which does not take into consideration application of such a circuit board to an automobile control unit and the use thereof in a high-temperature environment.

The Higashiguchi et al. patent discloses a semiconductor device having terminals for heat radiation. This patent has been cited by the Examiner for its teachings that the flexible circuit boards can be made polyimide films, polyester films, polycarbonate films or polyamide films. See, column 6, lines 4-6 of Higashiguchi et al. However, clearly nothing in Higashiguchi et al. remedies any of the deficiencies noted above with respect to Clayton. Even if one were to use the flexible circuit boards of Higashiguchi et al. in the multichip module of Clayton, it would appear that one would substitute the flexible circuit boards of Higashiguchi et al. for both of the thin laminate circuits 50 of Clayton. Again, this combination would

not render obvious the combined use of a multilayered wiring board and a polyimide wiring board on opposite sides of the heat sink, as presently claimed. Nor does the Higashiguchi et al. patent render obvious the manner in which the polyimide wiring board is bent at at least one end so that it is fixed to both surfaces of the heat sink. Nor does it suggest the manner in which the bonding wires connect the wiring boards to the external connection terminal, as presently claimed.

The Abbott publication discloses a lead frame for use with integrated circuit chips comprising a base metal, using copper or a copper alloy, having a modified surface adapted to provide bondability and solderability and adhesion to polymeric compounds. This document discloses that a molding compound encapsulates a mounted chip, bonding wires and first ends of leads segments, and that the molding compound is selected from a group consisting of epoxy-based thermoset molding compounds suitable for adhesion to the lead frame. However, it is submitted the Abbott publication does not remedy any of the basic deficiencies noted above with respect to Clayton and Higashiguchi et al. While Abbott discloses plating a copper layer on all of the lead frame surfaces (see 0054 of Abbott), the purpose of this plating is merely to simplify the control of the subsequent crown mate conversion process. It is submitted this teaching would not have provided any reason to make the cover plate 48 of Clayton of a clad material.

Accordingly, the presently claimed invention is patentable over the proposed combination of Clayton, Higashiguchi et al. and Abbott.

Claim 8 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Clayton, Higashiguchi et al., Abbott and further in combination with U.S. Patent Application Publication No. 2002/0088304 to Thorum et al. Applicants traverse this rejection and request reconsideration thereof.

The Examiner has cited the Thorum et al. publication as allegedly disclosing

an electronic circuit apparatus fixed on an interior of an automatic transmission assembly of an automobile. However, nothing in Thorum et al. would have provided any reason to modify the teachings of Clayton, Higashiguchi et al. and Abbot to arrive at the presently claimed invention. Accordingly, claim 8 is patentable over of the proposed combination references at least for the reasons noted above.

Claims 13, 15, 23 and 28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Clayton, Higashiguchi et al., Abbot and further in view of U.S. Patent Application Publication No. 2003/0152766 to Vargo et al. Applicants traverse this rejection and request reconsideration thereof.

The Vargo et al. publication discloses appliques comprising oxyhalopolymer-adhesive composites wherein the adhesive layer of the composite is chemically bonded to reactive sites on at least one side of the oxyhalopolymer layer, possess superior peel strengths, resistance to delamination and protective properties, including protection of surfaces from lightning strike to seamless protective liners for tanks. The appliques are suitable for printing architectural designs thereon. It is disclosed that the appliques find numerous applications for aircraft and spacecraft parts and assemblies, partial and complete fuselage panels, wings for enhancing laminar flow, reducing ice formation and friction, entire aircraft hulls, aircraft markings and decals; replacements for paints, including architectural or as decorative appliques suitable for printing, with emblems for use as transfer films and decals for rail cars, highway vehicles, including tractor-trailer rigs; protective films for marine vessels, and so on. The adhesive backed appliques also have numerous utilities for internal surfaces, such as protective liners for containment vessels in the chemical and food processing industries, to name but a few. There is absolutely no reason in Vargo et al. or in any of the other prior art for one of ordinary skill in the art to have applied the adhesive described in Vargo et al. to adhere a wiring board to a heat sink.

Moreover, even assuming, arguendo, one of ordinary skill in the art would have used the adhesive in this manner, it is submitted there is nothing in Vargo et al. that remedies any of the basic deficiencies noted above with respect to Clayton, Higashiguchi et al. and Abbott. Accordingly, claims 13, 15, 23 and 25 are patentable over the proposed combination of references.

Claims 20 and 29 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Clayton, Higashiguchi et al., and Abbot and further in combination with U.S. Patent No. 5,696,405 to Weld. Applicants traverse this rejection and request reconsideration thereof.

The Examiner has cited the Weld patent as allegedly disclosing a passage for circulating a cooling medium a resin composition. However, nothing in Weld remedies the deficiencies of the remaining documents and, therefore, claim 29 is patentable for at least the reasons noted above.

Accordingly, reconsideration and withdrawal of the rejection of claims 20 and 29 are requested.

Claims 30 and 31 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Clayton, Higashiguchi et al. and Abbot, and further in combination with U.S. Patent Application Publication No. 2004/0012078 A1 to Hortaleza. Applicants traverse this rejection and request reconsideration thereof. The Examiner has cited Hortaleza publication as disclosing a heat sink made of a clayed material having copper-inbar-cooper layers. However, clearly nothing in Hortaleza remedies the basic deficiencies noted above with respect to Clayton, Higashiguchi et al. and Abbot. Accordingly, claim 30 is patentable over the proposed combination of documents, at least for the reasons noted above.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all the claims now in the application are requested.

Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus Deposit Account No. 01-2135 (Case: 1021.43671X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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Attachments